PROGRAM ANNOUNCEMENT

- GameChanger 2007 - MULTIFUNCTIONAL DESIGN OF HYBRID COMPOSITES FOR LOAD BEARING ANTENNAS: Materials by Design, N-Reinforcement and Engineered Topography.

AFOSR BAA 2007-6

PROPOSAL DEADLINE:
3:00 p.m. Eastern Daylight Time
Friday, 2 March 2007

OVERVIEW INFORMATION

- **Agency Name(s) –** This program will be administered through the Air Force Office of Scientific Research (AFOSR).

- **Funding Opportunity Title –** GameChanger 2007 - MULTIFUNCTIONAL DESIGN OF HYBRID COMPOSITES FOR LOAD BEARING ANTENNAS: Materials by Design, N-Reinforcement and Engineered Topography.

- **Announcement Type –** This is the initial announcement.

- **Funding Opportunity Number -** AFOSR BAA 2007-6.

- **Catalog of Federal Domestic Assistance (CFDA Number(s) -** 12.800 -- Air Force Defense Research Sciences Program

- **Dates –** Letters of Intent should be postmarked on or before 8 January 2007.

  – Proposals should arrive by 3:00 PM Eastern Time, 2 March 2007.

- **Additional Overview Content -** To develop a scientific foundation for the design and manufacture of multifunctional hybrid composite systems required for new small UAV's with structurally integrated antenna functions for radar and communication missions and improved structural endurance.

I. Funding Opportunity Description

MULTIFUNCTIONAL DESIGN OF HYBRID COMPOSITES FOR LOAD BEARING ANTENNAS: Materials by Design, N-Reinforcement and Engineered Topography

Background: Small unmanned aerial vehicles (UAVs) in low-altitude operation can provide valuable real-time surveillance data to individual military units of action while remaining out of harm's way. Surveillance mission for prediction and detection of exogenous threats entails the use of high-performance antennas designed for radar and broadband communication functions. However, their values in the war-fighting environment are constrained by a number of factors. For instance, such communication missions as HAM radio, satellite radio, cellular phones or television are often precluded for small UAVs due to the large size of antennas required. Due to its high power requirement, the incorporation of antenna for radar system is often accompanied by extra payload of on-board power harvest or storage facilities. More innovative methods of incorporating the antenna function into small UAVs are needed to make the above-discussed missions feasible and to make the structures more efficient in meeting various functional requirements simultaneously.

Recent advances in materials and electronics as well as new design philosophies have already resulted in a number of innovations on this subject. The traditional division between antenna design (passive elements) and active electronic components (receiver/transmitter, amplifiers, mixer, etc.) is disappearing in favor of integrated systems where active and passive components are designed as one unit. These new antenna systems are, in turn, integrated into load-bearing structures of aerial vehicles, thereby resulting in unique multifunctional structures of hybrid composites. Good examples are conformal load bearing antenna systems (CLAS) which are embedded in the aerial vehicle structure with curvatures for aerodynamic reasons and which support the loads in addition to radiating or receiving electromagnetic energy. Here the surfaces of the wings, fuselage, and vertical stabilizer are considered as potential antennas, since the antenna system typically must be comparable in size to the wavelength to radiate or receive electromagnetic energy efficiently (unless high dielectric constant materials are used to slow down the electromagnetic wave).

In order to apply and expand the above-described novel concepts for the case of small UAVs with highly limited space, a number of questions on design, manufacture and performance remain to be answered. Considering the fact that volumetric antennas will have broader bandwidth than conventional linear antennas, the research efforts should include the development of optimum antenna geometries to achieve large bandwidth in the input impedance as well as the realized gain and proper combinations of materials compatible with the structural and aerodynamic constraints of small UAVs. Within this context, multi-directionally reinforced fiber composites in complex spatial configurations (called "N" reinforcement) can be envisioned to maximize antenna functionality as well

as structural reinforcement efficiency. Topography of hybrid materials systems can also be engineered to achieve optimum balance of different physical properties including electrical conductivity, thermal conductivity, specific heat, elastic modulus, strength, etc.

As an alternative, the development of entirely new composite reinforcement and matrix materials for dual functions of radiating/receiving electromagnetic energy and carrying the mechanical load should be attempted to achieve the design of truly multifunctional load-bearing structures with antenna function at the level of constituent materials. In pursuing the stated goals, an analytical framework should be formulated to achieve a fully integrated design procedure for multifunctional hybrid composite systems for small UAVs which exhibit optimum levels of electrical performance, mechanical reliability and environmental durability. Electromagnetic modeling tools in combination with the mechanics of multi-directionally reinforced fiber composites will play a crucial role in the development of design concepts for small UAVs.

Objective: (a) To develop a scientific foundation for the design and manufacture of multifunctional hybrid composite systems required for new small UAVs with structurally integrated antenna functions for radar and communication missions and improved structural endurance; and (b) to establish new multi-functional design rules of interdisciplinary nature for structural integration of antenna function and proper combinations of materials compatible with the structural and aerodynamic constraints of small UAVs.

Research Concentration Areas: Suggested research areas are as follows: (1) understanding and characterization of radar and communication missions of small UAVs and the constraints of surrounding environments; (2) the determination of system requirements for dual functions of radiating/receiving electromagnetic energy and carrying the mechanical load for newly proposed small UAVs; (3) establishment of multi-functional design rules for structural integration of antenna function and proper combinations of materials compatible with the structural and aerodynamic constraints; (4) molecular-level design, synthesis and processing of new reinforcement and matrix materials for multifunctional hybrid composites for small UAVs; (5) fabrication of hybrid composite structures with optimum composition, topography and spatial configuration and the characterization of their “multi-functional” performance; (6) manufacturing and interface sciences for the control of morphology, distribution and stability of multifunctional hybrid composite structures at various structural levels under extreme environments; (7) “validated” modeling and simulation for optimization of structural and electrical performance within multi-scale and physics-based framework.

Impact: UAV’s have amply demonstrated their value in military intelligence, surveillance and reconnaissance (ISR) operations. The establishment of new small UAV’s with structurally integrated antenna functions for radar and communication missions and improved structural endurance will provide valuable real-time surveillance data to individual military units of action. The design and

manufacture of multifunctional hybrid composite systems for new small UAVs will establish meaningful science base for the improvement of mission capabilities of ISR platforms in general. It will also open the door for a whole new generation of multifunctional load-bearing structures with autonomous sensing and monitoring capabilities in the near future.

Letter of Intent: Applicants are requested to submit to the Program Manager no later than 8 January 2007 a letter of intent describing in four pages or less the proposed research program. The letter should state the program objectives and identify participants in the Research Team and Research Concentration areas. A summary of the anticipated total project cost should also be included. Letters of Intent postmarked on or before 8 January 2007 will be accepted. Letters of Intent received after the deadline will not be considered for initial funding, but may be considered at a later date. **Please mail all Letters of Intent, Do Not Submit Letters of Intent through Grants.gov.**

Mail Letters of Intent to:

AFOSR/NA
Attn: Dr. B.L. Lee
875 North Randolph Street, Suite 325 Room 3112
Arlington VA 22203

Please Notate on Envelopes: GameChanger 2007 Letter of Intent Enclosed

The program coordinator will respond to letters of intent no later than 31 January 2007 with comments concerning the suitability of the proposed project for the program.

II. Award Information

The anticipated type of award is project grant, cooperative agreement or contract to a multidisciplinary research team. The project may receive funding up to $1 M per year for a maximum of three years.

III. Eligibility Information

1. **Eligible Applicants –** This competition is open to all respondents.

Proposals are encouraged from historically Black Colleges and Universities and Minority Institutions (HBCU/MI), as defined by 10 U.S.C. 2323. Accredited U.S. postsecondary institutions that meet the statutory criteria for identification as minority institutions are listed at the following Department of Education web site: www.ed.gov/offices/OCR/minorityinst.html. However, no funds are specifically allocated for HBCU/MI participation.

2. **Cost Sharing or Matching –** Cost Sharing is not required.

3. **Other –**There are no limits to the number of applications an applicant may submit.

IV. Application and Submission Information

1. Address for Application Package - This announcement may be accessed from the Internet from the "Other Opportunities" portion of AFOSR's web site (http://www.afosr.af.mil/) through the "Need Funding?" link

2. Marking of Proposals - Every effort should be made to protect the confidentiality of the proposal and any evaluations. However, under the Freedom of Information Act (FOIA) requirements, such information (or portions thereof) may potentially be subject to release. The proposer must mark the proposal with a protective legend found in FAR Part 15.609, Limited Use of Data, (modified to permit release to outside evaluators retained by AFOSR) if protection is desired for proprietary or confidential information.

3. Content and Form of Application Submission –

Full Proposals. The proposal may be submitted either electronically or in hard copy form, but not both. All proposers must include the SF 424 (R&R) form as the cover page. Proposals of more than 35 total pages, including cover page and budget, are discouraged.

Full Proposal Format

- Paper Size – 8.5 x 11 inch paper
- Margins – 1 inch
- Spacing – 1.5 line spacing
- Font – Times New Roman, 12 point
- Page Limitation – 35 pages
- 11 Copies for hardcopy submissions – (one original, ten copies)
- Content – as described below

(1) <u>Advanced Preparation For Electronic Submission</u> - Electronic proposals must be submitted through Grants.gov. There are several one-time actions your organization must have completed before it will be able to submit applications through Grants.gov. Well before the submission deadline, you should verify that the persons authorized to submit proposals for your organization have completed those actions. If not, it may take them up to 21 days to complete the actions before they will be able to submit applications.

The process your organization must complete includes obtaining a Dun and Bradstreet Data Universal Numbering System (DUNS) number,

registering with the Central Contract Registry (CCR), registering with the credential provider, and registering with Grants.gov. (Designating an E-Business Point of Contact (EBiz POC) and obtaining a special password called MPIN are important steps in the CCR registration process.) Go to http://www.grants.gov/applicants/get_registered.jsp. Use the Grants.gov Organization Registration Checklist at http://www.grants.gov/section3/OrganizationRegCheck.pdf to guide you through the process. If a proposal is submitted through Grants.gov, PureEdge Viewer will need to be downloaded. This small, free program will allow you to access, complete, and submit applications electronically and securely. For a free version of the software, visit the following web site: www.Grants.gov/DownloadViewer. Should you have questions relating to the registration process, system requirements, how an application form works or the submittal process, call Grants.gov at 1-800-518-4726 or support@Grants.gov.

(2) Submitting the Application

(a) For Electronic Submission – Application forms and instructions are available at Grants.gov. To access these materials, go to http://www.grants.gov, select "Apply for Grants", and then select "Download Application Package". Enter the CFDA number for AFOSR which is 12.800, Air Force Defense Research Sciences Program (AFOSR). You should also enter the funding opportunity number for this announcement (AFOSR BAA 2007-6). Then follow the prompts to download the application package.

(b) For Hard Copy Submission – For hard copy submission, the original proposal and ten copies must be delivered to the attention of the program manager at the Air Force Office of Scientific Research at the following address:

AFOSR/NA, GameChanger
Attn: Dr. B.L. Lee
875 North Randolph Street, Suite 325 Room 3112
Arlington VA 22203

(c) SF 424 Research and Related (R&R) - The SF 424 (R&R) form must be used as the cover page for all electronic and hard copy proposals. No other sheets of paper may precede the SF 424 (R&R) for a hard copy proposal. A signed copy of the SF 424 (R&R) should be submitted with all hard copy proposals. Complete all the required fields in accordance with the "pop-up" instructions on the form and the following instructions for the specified fields. To activate the instructions, turn on the "Help Mode" in Grants.gov. (The "Help Mode" is turned on by the icon with the pointer and question mark. This is

located at the top of the form). The completion of most of the fields is self-explanatory except the following special instructions:

- Field 3: The State Application Identifier may be left blank.

- Field 7: Complete as indicated. Please note under "Other (Specify)" if your organization is a Minority Institution (MI).

- Field 8: Complete fields as indicated.

- Field 9: List AFOSR as the reviewing agency.

- Field 20: Use Field 20 to attach the proposal narrative as described in (f) below.

(d) Other forms: The following other forms must be used for all electronic and hard copy proposals. R&R Budget form, R&R Senior/Key Person Profile form, R&R Project/Performance Site Locations form and R&R Other Project Information form. These forms are available on the grants.gov site. For any mandatory (yellow) fields on the Research & Related Other Project Information form requesting attachments you can attach a short word document which refers the reader back to Field 20 of the SF 424 R&R. If a field is marked by an asterisk it is labeled mandatory by Grants.gov and will remain yellow until you fill it in. If you do not make the required input, Grants.gov will not validate your data and AFOSR will not be able to retrieve your submission.

(e) Certification - All awards require some form of certifications of compliance with national policy requirements. For assistance awards, i.e., grants and cooperative agreements, proposers using the SF 424 (R&R) are providing the certification required by 32 CFR Part 28 regarding lobbying. (The full text of this certification may be found at http://www.afosr.af.mil/Documents/funding_GrantCertForm.htm or a copy will be provided upon request.)

(f) Proposal Narrative – Attach the proposal narrative to the SF 424 (R&R) cover sheet (for an application submitted through Grants.gov, electronically attach the proposal narrative at Field 20). The proposal narrative contains the abstract, technical proposal, budget and supplementary information as follows:

- Abstract. Include a concise (not to exceed 300 words) abstract that describes the proposed research.

- Technical Proposal.

--Introduction and Background Information

-- Describe in detail the research to be performed keeping in mind the evaluation criteria listed in Section V of this announcement.

-- Briefly address whether the intended research will result in environmental impacts outside the laboratory, and how the proposer will ensure compliance with environmental statutes and regulations.

--References

- Budget. The financial portion of the proposal must contain a cost estimate for the proposed effort including a description of cost sharing arrangements, if any. It is anticipated that the awards will have a period of performance of three years beginning 1 May 2007. Individual budgets should be provided for each 12 month period. Should a grant be awarded AFOSR will make payment to educational recipients based upon a predetermined payment schedule. Payments will normally be made quarterly in advance of performance, based upon a spending profile which must be provided as part of the proposal. Payments should be limited to the amounts needed to conduct research during each respective period. Educational and nonprofit organizations shall submit a spending profile with their cost proposal. For further details, proposers may refer to the "Proposer's Guide to AFOSR Research Programs" (http://www.afosr.af.mil/ResearchAreas/funding_submitProp.htm).

4. Other Submission Requirements

Proposals submitted in whole or in part by electronic media (computer disk or tape, facsimile machine, electronic mail, etc.) will not be accepted unless the full proposal is submitted electronically through Grants.gov.

If a contract is planned as the award instrument and the proposal exceeds $550,000, a Small Business Subcontracting Plan is required in accordance with FAR 52.219-9.

5. Application Receipt Notices.

a. For Electronic Submission - The applicant will receive a confirmation page upon completing the submission to Grants.gov. The applicant will receive an e-mail within a few hours of submission indicating that the proposal has been validated by Grants.gov. (This means that all the required fields have been completed.) The third notice the applicant will

receive is an e-mail from the designated agency to which the electronic proposal was submitted, to acknowledge receipt of the proposal and provide the agency's assigned tracking number. The email is sent to the authorized representative for the applicant institution approximately ten days from the proposal due date.

b. For Hard Copy Submission – An applicant that submits a hard copy proposal to AFOSR will receive an e-mail from the agency approximately ten days after the proposal due date to acknowledge receipt of the proposal and provide the agency's assigned tracking number. The e-mail is sent to the authorized representative for the applicant institution.

6. Submission Dates and Times. Letters of Intent must be postmarked by 8 January 2007. Proposals must be received at AFOSR by 3:00 PM, EST, 2 March 2007.

V. Application Review Information

1. Criteria: Proposals under this Broad Agency Announcement (BAA) will be evaluated through a peer or scientific review process, and selected for award on a competitive basis according to Public Law 98-369, Competition in Contracting Act of 1984, 10 U S C 2361, and 10 U S C 2374. All other proposals will be evaluated under the following two primary criteria, of equal importance, as follows:

1. The scientific and technical merits of the proposed research in the context of the objectives of the theme

2. The potential contributions of the proposed research to the mission of the Air Force.

Other evaluation criteria used in the technical reviews, which are of lesser importance than the primary criteria and of equal importance to each other, are as follows:

1. The likelihood of the proposed effort to develop new research capabilities and broaden the research base in support of U.S. national defense.

2. Qualification, capabilities and related experience of key personnel, facilities, or techniques or a combination of these factors that is integral to achieving USAF objectives.

3. The proposer's and associated personnel's record of past performance.

4. The realism and reasonableness of proposed costs and availability of funds.

No further evaluation criteria will be used in source selection. The technical and cost information will be analyzed simultaneously during the evaluation process.

VI. Award Administration Information:

1. Award Notices

Should your proposal be selected for award, the principal investigator will receive a letter from the Technical Directorate stating this information. This is not an authorization to begin work. Your business office will be contacted by the grant or contracting officer to negotiate the terms of your award.

2. Reporting Requirements

Grants and cooperative agreements typically require annual and final technical reports, financial reports, and final patent reports. Contracts typically require annual and final technical and patent reports. Copies of publications and presentations should be submitted. Additional deliverables may be required based on the research being conducted

VII. Agency Contact(s): Address questions to:

GameChanger Program Managers:

Dr. B. L. ("Les") Lee (703) 696-8483; byunglip.lee@afosr.af.mil or les.lee@afosr.af.mil (**Theme Coordinator** and Mechanics of Multifunctional Materials and Microsystems),

Dr. Arje Nachman, (703) 696-8427, arje.nachman@afosr.af.mil (Physical Mathematics and Electromagnetics)

Maj Ryan Umstattd, AFOSR/NE, (703) 696-8411, ryan.umstattd@afosr.af.mil (Electromagnetic Disruption/Detection Physics)

Should you have questions about the BAA or procedures for submission of a proposal, contact Ricky Christie at ricky.christie@afosr.af.mil or (703) 696-5968 or Kathy Wetherell at kathy.wetherell@afosr.af.mil or (703) 696-9738.